

WHAT IS CLAIMED IS:

1. A magnetoresistive device, comprising:

a magnetization pinned layer of which  
magnetization direction is substantially pinned to one  
direction;

a magnetization free layer of which magnetization  
direction is changed in accordance with an external  
magnetic field;

a nonmagnetic intermediate layer formed between  
the magnetization pinned layer and the magnetization  
free layer; and

electrodes allowing a sense current to flow in  
a direction substantially perpendicular to the plane of  
the stack including the magnetization pinned layer, the  
nonmagnetic intermediate layer and the magnetization  
free layer,

wherein at least one of the magnetization pinned  
layer and the magnetization free layer is substantially  
formed of a binary alloy or a ternary alloy represented  
by general formula (1) or (2) given below:



where T1 and T2 are different from each other and  
selected from the group consisting of Fe, Co and Ni,

25 at%  $\leq a \leq 75$  at%, 25 at%  $\leq b \leq 75$  at%, and

$a + b = 100$ ; and

$0 < c \leq 75$  at%,  $0 < d \leq 75$  at%,  $0 < e \leq 63$  at%,

and  $c + d + e = 100$ .

2. A magnetoresistive device, comprising:

a magnetization pinned layer of which  
magnetization direction is substantially pinned to one  
5 direction;

a magnetization free layer of which magnetization  
direction is changed in accordance with an external  
magnetic field;

a nonmagnetic intermediate layer formed between  
10 the magnetization pinned layer and the magnetization  
free layer; and

electrodes allowing a sense current to flow in  
a direction substantially perpendicular to the plane of  
the stack including the magnetization pinned layer, the  
15 nonmagnetic intermediate layer and the magnetization  
free layer,

wherein at least one of the magnetization pinned  
layer and the magnetization free layer is formed of  
an alloy represented by general formula (3) or (4)  
20 given below:

$$(T1_a/100T2_b/100)^{100-x}M1_x \quad (3)$$

$$(T1_c/100T2_d/100T3_e/100)^{100-x}M1_x \quad (4)$$

where  $T1$ ,  $T2$  and  $T3$  are different from each other  
and selected from the group consisting of Fe, Co and  
25 Ni;  $M1$  is at least one element selected from the group  
consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga,  
Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B,

Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F;

25 at%  $\leq a \leq 75$  at%, 25 at%  $\leq b \leq 75$  at%, and

$$a + b = 100;$$
$$5 \text{ at\%} \leq c \leq 90 \text{ at\%}, 5 \text{ at\%} \leq d \leq 90 \text{ at\%},$$

5            5 at%  $\leq e \leq 90$  at%, and  $c + d + e = 100$ ; and

$$0.1 \text{ at\%} \leq x \leq 30 \text{ at\%}.$$

3. A magnetoresistive device, comprising:

a magnetization pinned layer of which

magnetization direction is substantially pinned to one  
10 direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between  
15 the magnetization pinned layer and the magnetization  
free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (5) given below:

$$\text{Fe}_{100-a}\text{Tl}_a \quad (5)$$

where  $T_1$  is at least one element selected from the

group consisting of Co, Cr, V, Ni, Rh, Ti, Mo, W, Nb, Ta, Pd, Pt, Zr and Hf; and

0 at%  $\leq a < 70$  atomic %;

and wherein the alloy has a body-centered cubic crystal structure.

4. A magnetoresistive device, comprising

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (6) given below:

$$\text{Fe}_{100-a}\text{Tl}_a \quad (6)$$

where

0 at%  $\leq a \leq 80$  at%, in the case where Tl is Co;

0 at%  $\leq$  a  $\leq$  80 at%, in the case where T1 is Cr;

0 at%  $\leq$  a  $\leq$  70 at%, in the case where T1 is V;

0 at%  $\leq$  a  $\leq$  20 at%, in the case where T1 is Ni;

0 at%  $\leq$  a  $\leq$  55 at%, in the case where T1 is Rh;

5 and

0 at%  $\leq$  a  $\leq$  51 at%, in the case where T1 is Ti;

and wherein the alloy has a body-centered cubic  
crystal structure.

5. A magnetoresistive device, comprising:

10 a magnetization pinned layer of which  
magnetization direction is substantially pinned to one  
direction;

a magnetization free layer of which magnetization  
direction is changed in accordance with an external  
15 magnetic field;

a nonmagnetic intermediate layer formed between  
the magnetization pinned layer and the magnetization  
free layer; and

electrodes allowing a sense current to flow in  
20 a direction substantially perpendicular to the plane of  
the stack including the magnetization pinned layer, the  
nonmagnetic intermediate layer and the magnetization  
free layer,

wherein at least one of the magnetization pinned  
25 layer and the magnetization free layer is formed of a  
ternary alloy selected from the group consisting of an  
Fe-Co-Ni alloy, a Co-Mn-Fe alloy and an Fe-Cr-Co alloy;

and wherein the ternary alloy has a body-centered cubic crystal structure.

6. A magnetoresistive device, comprising:

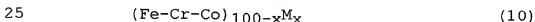
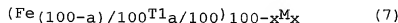
5 a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

10 a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

15 electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

20 wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by any of general formulas (7) to (10) given below:



where Tl is at least one element selected from the group consisting of Co, Cr, V, Ni, Rh, Ti, Mo, W, Nb,

Ta, Pd, Pt, Zr and Hf, and  $0 \text{ at}\% \leq a < 70 \text{ atomic}\%$ ;

the Fe-Co-Ni alloy is in a composition region forming a body-centered cubic crystal;

the Co-Mn-Fe alloy is in a composition region  
5 forming a body-centered cubic crystal structure;

the Fe-Cr-Co alloy is in a composition region forming a body-centered cubic crystal structure;

0.1 at%  $\leq x \leq 20 \text{ at}\%$ , in the case where M is at least one element selected from the group consisting of  
10 Mn, Cu, Re, Ru, Pd, Pt, Ag, Au and Al; and

0.1 at%  $\leq x \leq 10 \text{ at}\%$ , in the case where M is at least one element selected from the group consisting of Sc, Zn, Ga, Ge, Zr, Hf, Y, Tc, B, In, C, Si, Sn, Ca, Sr, Ba, O, F and N;

15 and wherein the alloy has a body-centered cubic crystal structure.

7. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one  
20 direction;

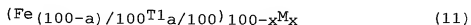
a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between  
25 the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in

a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (11) given below:



where

0 at%  $\leq a \leq 80$  at%, in the case where Tl is Co;

0 at%  $\leq a \leq 80$  at%, in the case where Tl is Cr;

0 at%  $\leq a \leq 70$  at%, in the case where Tl is V;

0 at%  $\leq a \leq 10$  at%, in the case where Tl is Ni;

0 at%  $\leq a \leq 55$  at%, in the case where Tl is Rh;

0 at%  $\leq a \leq 51$  at%, in the case where Tl is Ti;

0.1 at%  $\leq x \leq 20$  at%, in the case where M is at

least one element selected from the group consisting of Mn, Cu, Re, Ru, Pd, Pt, Ag, Au and Al; and

0.1 at%  $\leq x \leq 10$  at%, in the case where M is at least one element selected from the group consisting of Sc, Zn, Ga, Ge, Zr, Hf, Y, Tc, B, In, C, Si, Sn, Ca, Sr, Ba, O, F and N;

and wherein the alloy has a body-centered cubic crystal structure.

8. A magnetoresistive device, comprising:

a magnetization pinned layer of which



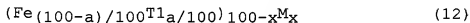
magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (12) given below:



where Tl is at least one element selected from the group consisting of Co and Ni, and  $0 \text{ at}\% \leq a \leq 50 \text{ at}\%$ ; and

M is at least one element selected from the group consisting of Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and  $0.1 \text{ at}\% \leq x \leq 30 \text{ at}\%$ .

9. A magnetoresistive device, comprising:

a magnetization pinned layer of which

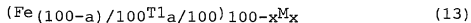
magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (13) given below:



where Tl is at least one element selected from the group consisting of Co and Ni, and  $0 \text{ at}\% \leq a \leq 50 \text{ at}\%$ ; and

M is at least one element selected from the group consisting of Cu, Zn and Ga, and  $0.1 \text{ at}\% \leq x \leq 30 \text{ at}\%$ .

10. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

5 a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

10 electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

15 wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (14) given below:



where M is at least one element selected from the group consisting of Co and Ni, and  $0.1 \text{ at\%} \leq x \leq 5 \text{ at\%}$ .

20 11. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

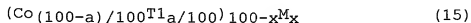
25 a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between

the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (15) given below:



where Tl is at least one element selected from the group consisting of Fe and Ni, and  $0 \text{ at}\% \leq a \leq 50 \text{ at}\%$ ; and

M is at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and  $0.1 \text{ at}\% \leq x \leq 30 \text{ at}\%$ .

12. A magnetoresistive device, comprising:

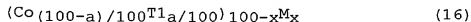
a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (16) given below:



where Tl is at least one element selected from the group consisting of Fe and Ni, and  $0 \text{ at}\% \leq a \leq 50 \text{ at}\%$ ; and

M is at least one element selected from the group consisting of Sc, Ti, Mn, Cu and Hf, and  $0.1 \text{ at}\% \leq x \leq 30 \text{ at}\%$ .

13. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between

the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (17) given below:



where M is at least one element selected from the group consisting of Fe and Ni, and  $0.1 \text{ at\%} \leq x \leq 5 \text{ at\%}$ .

14. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

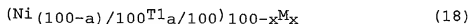
a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of

the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned  
5 layer and the magnetization free layer is substantially formed of an alloy represented by general formula (18) given below:



where Tl is at least one element selected from the  
10 group consisting of Co and Fe, and  $0 \text{ at}\% \leq a \leq 50 \text{ at}\%$ ; and

M is at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au,  
15 B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and  $0.1 \text{ at}\% \leq x \leq 30 \text{ at}\%$ .

15. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one  
20 direction;

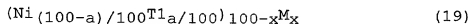
a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between  
25 the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in

a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

5           wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (19) given below:



10           where Tl is at least one element selected from the group consisting of Fe and Co, and  $0 \text{ at}\% \leq a \leq 50 \text{ at}\%$ ; and

          M is at least one element selected from the group consisting of Sc, Ti, Mn, Zn, Ga, Ge, Zr and Hf, and  
15            $0.1 \text{ at}\% \leq x \leq 30 \text{ at}\%$ .

16. A magnetoresistive device, comprising:

          a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

20           a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

          a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization  
25           free layer; and

          electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of

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the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (20) given below:



where M is at least one element selected from the group consisting of Fe and Co, and  $0.1 \text{ at\%} \leq x \leq 5 \text{ at\%}$ .

17. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

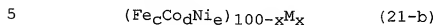
a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned

layer and the magnetization free layer is substantially formed of a binary alloy or a ternary alloy represented by general formula (21-a) or (21-b) given below:



where T1 and T2 are different from each other and selected from the group consisting of Fe, Co and Ni, 25 at%  $\leq a \leq 75$  at%, 25 at%  $\leq b \leq 75$  at%, and  $a + b = 100$ ;

0 < c  $\leq 75$  at%, 0 < d  $\leq 75$  at%, 0 < e  $\leq 63$  at%, and  $c + d + e = 100$ ; and

M is at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and 0.1 at%  $\leq x \leq 20$  at%.

18. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in

a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

5            wherein at least one of the magnetization pinned layer and the magnetization free layer has a laminate structure comprising alternately laminated layers of:

          (i) at least one layer substantially formed of an alloy represented by general formula (22-a) or

10            (22-b) given below:



          where T1 and T2 are different from each other and selected from the group consisting of Fe, Co and Ni,

15            25 at%  $\leq a \leq$  75 at%, 25 at%  $\leq b \leq$  75 at%, and  
           $a + b = 100$ ; and

$0 < c \leq 75$  at%,  $0 < d \leq 75$  at%,  $0 < e \leq 63$  at%,  
          and  $c + d + e = 100$ ; and

20            (ii) at least one layer formed of at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and having a thickness falling within a range of between 0.03 nm and 1 nm.

25            19. A magnetoresistive device, comprising:

          a magnetization pinned layer of which magnetization direction is substantially pinned to one

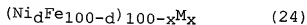
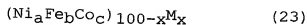
direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

5 a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

10 electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

15 wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (23) or (24) given below:



20 where  $0 < a \leq 75 \text{ at\%}$ ,  $0 < b \leq 75 \text{ at\%}$ ,  
 $0 < c \leq 75 \text{ at\%}$ , and  $a + b = 100$ ;  
 $75 \text{ at\%} \leq d \leq 85 \text{ at\%}$ ; and

25 M is at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and

$0.1 \text{ at\%} \leq x \leq 20 \text{ at\%}$ .

20. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

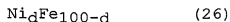
5 a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

10 electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

15 wherein at least one of the magnetization pinned layer and the magnetization free layer has a laminate structure comprising alternately laminated layers of:

(i) at least one layer substantially formed of an alloy represented by general formula (25) or (26)  
20 given below:



where  $0 < a \leq 75 \text{ at\%}$ ,  $0 < b \leq 75 \text{ at\%}$ ,  
 $0 < c \leq 75 \text{ at\%}$ , and  $a + b = 100$ ; and

25  $75 \text{ at\%} \leq d \leq 85 \text{ at\%}$ ; and

(ii) at least one layer formed of at least one element selected from the group consisting of Cr, V,

Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and having a thickness falling within a range of between 0.03 nm and 1 nm.

21. A magnetoresistive device, comprising:

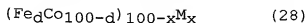
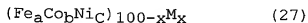
a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein the magnetization pinned layer is substantially formed of an alloy represented by general formula (27) or (28) given below:

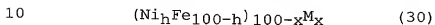
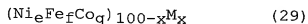


where  $0 < a \leq 75 \text{ at\%}$ ,  $0 < b \leq 75 \text{ at\%}$ ,  $0 < c \leq 75 \text{ at\%}$ , and  $a + b = 100$ ;  $45 \text{ at\%} \leq d \leq 55 \text{ at\%}$ ; and

M is at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and

5      0.1 at%  $\leq x \leq 20$  at%,

and wherein the magnetization free layer is substantially formed of an alloy represented by general formula (29) or (30) given below:



where 60 at%  $\leq e \leq 75$  at%, 12.5 at%  $\leq f \leq 20$  at%, 12.5 at%  $\leq g \leq 20$  at%, and  $e + f + g = 100$ ;  
75 at%  $\leq h \leq 85$  at%; and

15      M is at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and  
0.1 at%  $\leq x \leq 20$  at%.

22. A magnetoresistive device, comprising:

20      a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

25      a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

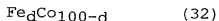
    a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization

free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein the magnetization pinned layer has a laminate structure comprising alternately laminated layers of:

(i) at least one layer substantially formed of an alloy represented by general formula (31) or (32) given below:



where  $0 < a \leq 75 \text{ at\%}$ ,  $0 < b \leq 75 \text{ at\%}$ ,  $0 < c \leq 75 \text{ at\%}$ , and  $a + b = 100$ ;  $45 \text{ at\%} \leq d \leq 55 \text{ at\%}$ ; and

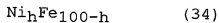
(ii) at least one layer formed of at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and having a thickness falling within a range of between 0.03 nm and 1 nm,

and wherein the magnetization free layer has a laminate structure comprising alternately laminated layers of:

(i) at least one layer substantially formed of



an alloy represented by general formula (33) or (34)  
given below:



5        where  $60 \text{ at}\% \leq e \leq 75 \text{ at}\%$ ,  $12.5 \text{ at}\% \leq f \leq$   
20 at%,  $12.5 \text{ at}\% \leq g \leq 20 \text{ at}\%$ , and  $e + f + g = 100$ ;  
75 at%  $\leq h \leq 85 \text{ at}\%$ ; and

(ii) at least one layer formed of at least one  
element selected from the group consisting of Cr, V,  
10    Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re,  
Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca,  
Sr, Ba, O, N and F, and having a thickness falling  
within a range of between 0.03 nm and 1 nm.

23. A magnetic head comprising the magneto-  
15    resistive device according to any of claims 1 to 22.

24. A magnetic recording-reproducing apparatus,  
comprising a magnetic recording medium, and the  
magnetoresistive device according to any of claims 1  
to 22.